UNIVERSITI TEKNOLOGI MARA

PREPARATION, CHARACTERIZATION AND MODIFICATION OF ACTIVATED CARBON FOR ARSENIC REMOVAL FROM WATER

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of the requirements for the degree of
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CONFIRMATION BY PANEL OF EXAMINERS

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I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledge as referenced work. This thesis has not been submitted to any other academic institutions or non-academic institution for any degree or qualification.

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ABSTRACT

Arsenic, a highly toxic contaminant in drinking water had threatened all types of living thing in the world. The inorganic forms of arsenic which are arsenic (III) and arsenic (V) are the most common forms of arsenic that contaminating the underground water. Available technologies for arsenic removal in water are more efficient for arsenic (V) removal since oxidation state of arsenic (V) has make it less mobile compare to arsenic (III) and tends to co-precipitate out with metallic cation or to adsorb onto solid surface. Different types of adsorbents such as Activated Carbon (AC) have been tested by many researchers. However, the removal level of the activated carbon does not meet the World Health Organization (WHO) guidelines level of 10 ppb since arsenic (III) species are completely neutral and difficult to adsorb on the less polar activated carbon surface. In this work, AC was prepared from Palm Kernel Shell (PKS) and was activated using steam followed by surface modification for arsenic removal from water. Influencing parameter such as activation temperature ranges of 500-800^{0}C and activation time ranges of 30-150 minutes which affecting the formation pore size resulting in AC adsorption surface area was studied. The AC was characterized by determination of methylene blue number, iodine value and Brunauer-Emmett-Teller (BET) surface area. It was found that the optimum activation temperature of PKS was obtained at 750°C with iodine value of 769 mg/g and BET surface area of 1286 m^2/g in determining the optimum temperature for activation with constant activation time of 1 hour. Meanwhile on the optimum activation time study, it was found that the constant activation temperature of 750°C and 90 minutes of activation time gave the highest iodine value of 696 mg/g with BET surface area of 1350m^2/g. When iron range of 5-15 % was loaded on raw PKS and PKS char, followed by steam activation at 750^{0}C for 90 minutes, higher Methylene blue uptake trend was obtained by AC with iron loaded on raw PKS compare to those loaded on PKS char. However all of AC loaded on raw PKS and PKS char showed decreasing trend of iodine value with increasing trend of iron concentration, thus indicating good iron dispersion in some micropores which in turn would be effective for arsenic separation. This also indicates that amount of impregnated material effect the adsorption properties of AC. The efficiency of arsenic removal was studied in batch and continuous column by using pure synthesis AC and iron loaded AC that were prepared by loading with 10 % iron on raw PKS term as FACC 2. Pure synthesized AC showed poor removal of arsenic (III) with only maximum 52% of it can be removed in batch adsorption process, while it is 48% in continuous column adsorption process. It was also noted that bed thickness of AC affected the arsenic (III) removal efficiency significantly. Meanwhile almost complete (99%) arsenic (III) can be removed from water using FACC 2 both in continuous column filtration system as well as large scale filtration, 24 L/day.

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